REEXAMINING THE U-PB CHRONOMETRY OF THE EARLY SOLAR SYSTEM. Fouad Tera and Richard W. Carlson, Department of Terrestrial Magnetism, Carnegie Institution of Washington, 5241 Broad Branch Rd, NW, Washington DC 20015.

Phosphates from ordinary chondrites were found to have concordant U-Pb systematics, when corrected for primordial Pb (1). We provide an alternative interpretation of the chronological significance of these results: As shown in Fig. 1, the phosphates define a Pb-Pb linear trend corresponding to distinctly younger ages than the age of the whole rocks hosting them. Furthermore, the composition of initial Pb in a phosphate is evolved to values significantly higher than those of primordial Pb, denoted PAT in Fig. 1. Thus, while he whole rocks appear to have evolved in a single stage from PAT, the phosphates seem to require at least two stages. Consequently, subtracting PAT as the initial Pb for phosphates leaves behind first-stage radiogenic Pb that is enriched in *(^{207}Pb) relative to *(^{206}Pb). For a given first-stage interval T - t (where T is a rock's age, and t is the age of its phosphate), the degree of Pb evolution beyond primordial is proportional to the value of $\mu_1 = (^{238}U/^{204}Pb)_1$. In contrast, the Pb composition of the phosphate (being an average of the two stages) depends on the fractionation factor $F = (\mu_2/\mu_1)$, where the subscript 2 refers to the crystallization or metamorphism of the phosphate at t. As is demonstrated by a hypothetical example in Fig. 2, it follows that (1) A single-stage model age of a phosphate (let us denote it t') is an upper limit. i.e., t' > t; (2) for cases with F < 1 the pattern is t' > T > t; i.e., t' >> t (see Fig. 2); (3) for cases with F > 1 the pattern is T > t' > t, and at F > 10, t' approaches t. (see Fig. 2); (4) for the ages considered, the cord corresponding to the T-t interval is tangential to concordia; thus although **false**, t' ages are **concordant** (see Fig. 2); (5) in accord with the definition of the F parameter, the above conclusions are not dependent on whether a phosphate is strongly radiogenic or not.

The Pb isotopic compositions of the whole rocks shown in Fig. 1, appear consistent with PAT being the initial Pb. However, when all recent data on ordinary chondrites [1,2] are considered, an apparent affinity for terrestrial contamination is revealed (see Fig. 3). In Fig. 4, we show the same Pb data (uncorrected for any initial) on the modified concordia diagram, where a clear-cut deviation

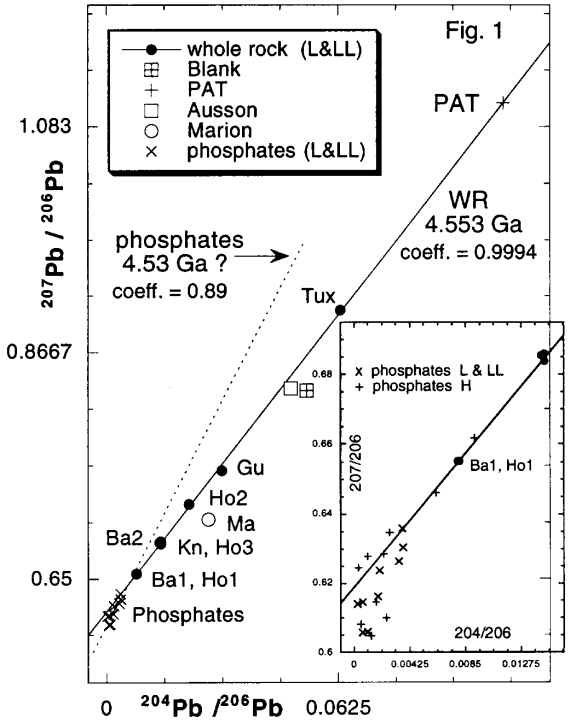

Fig. 1. Eight out of 10 samples analyzed (1), define a WR Pb-Pb isochron of 4.553 Ga for the L & LL chondrites. The isochron appears consistent with PAT as the initial Pb. Phosphates of these rocks (1) plot distinctly below the isochron and appear consistent with initial Pb well evolved beyond PAT. Abbreviations are: Barwell, Guidder, Homestead, Knyahinya and Tuxtuac. Inset shows phosphates from L, LL and H chondrites.

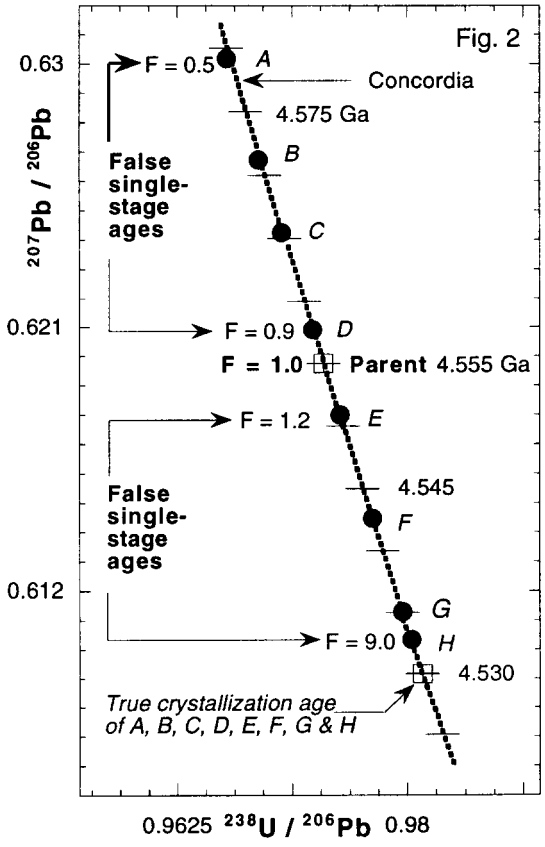

Fig. 2. A hypothetical example of 8 rocks, A, B, C, D, E, F, G, and H, which crystallized 4.530 Ga ago (with a fractionation factor $F = (\mu_2/\mu_1)$, ranging from 0.5 to 9.0), from a 4.555 Ga parent. Single-stage calculation (in which PAT is subtracted as the initial), yields a spectrum of false ages that are concordant and all > 4.530 Ga.

from PAT is exposed. However, despite such deviation, the data define a mixing line which intersects concordia at 4.553 Ga, which is the Pb-Pb isochron age in Fig. 1. We estimate that the end member of the mixing line (in Fig. 4) is composed of ~ 10% PAT and ~ 90% modern terrestrial Pb. This indicates that the true μ values of ordinary chondrites are much higher than the determined ones, being respectively in the range from 10 to 500 and 20 to 800 for the H and the L (+LL) classes. If high μ values resulted from metamorphism at a time earlier than 4.553 Ga, then either: (a) their initial Pb is more evolved than PAT and constitutes << 10% of the end member (in Fig. 4), or (b) the initiation of the first stage was too close to 4.553 Ga to evolve beyond PAT. However, if μ was extremely low, then even an extended first stage may not be detected.

References: [1] C. Göpel, G. M. Manhès and C. J. Allègre. Earth and Planet. Sci. Lett. 121 (1994) 153-171. [2] D. M. Unruh. Earth and Planet. Sci. Lett. 58 (1982) 75-94.

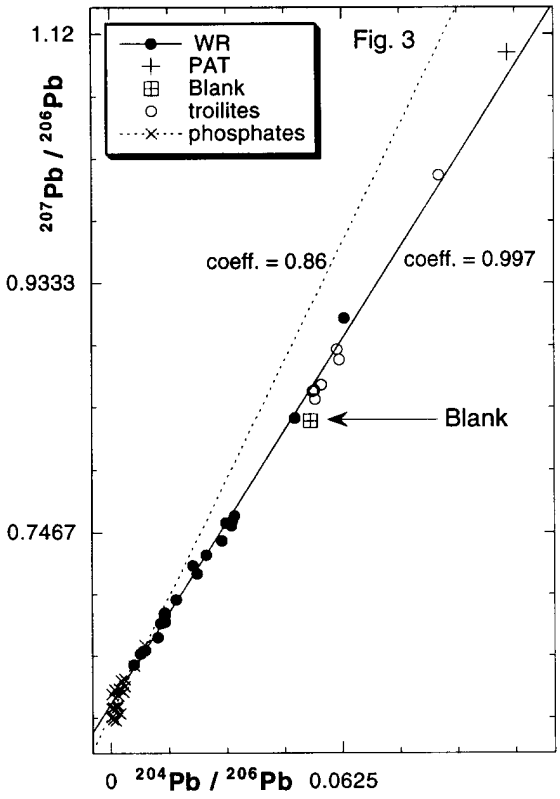

Fig. 3. Recent Pb data on ordinary chondrites (1, 2). An apparent general affinity for terrestrial Pb contamination (denoted "Blank") is indicated.

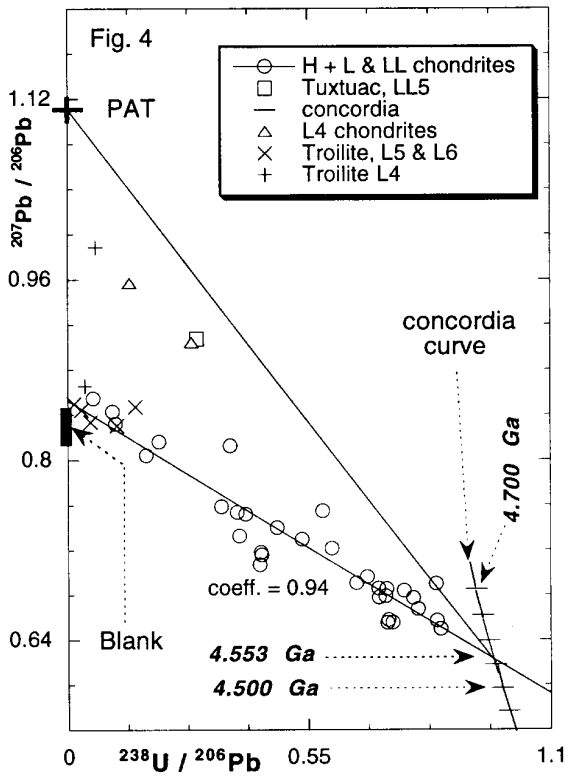

Fig. 4. Ordinary chondrites' U-Pb data (1, 2) shown without correction for initial Pb. Gross deviation from PAT is evident. Intersection with concordia (i. e. radiogenic end member) is at 4.553 Ga. Non-radiogenic end member may be 90% Terrestrial Pb and 10% PAT. Troilites, Tuxtuac & L4 chondrites are not included in fitting the line.